**Thermochemical Snacktime!**

**Outline:** In this short demo, you will be burning several snack foods for students and they will guess which has the most calories. This is a great introduction to calorimetry and is a great tie-in to nutrition.

Key terms: *Calorimetry, Calorimeter, specific heat capacity, q=mc∆T, calorie, Calorie, 4.184J/g˚C*

**Placement:**

After the introduction of heat, this is a great introduction to calorimetry.

**Ministry Expectations:**  Grade 12 University Chemistry – SCH4U – Thermochem

**D2.1** Use appropriate terminology related to energy changes and rates of reaction, including, but not limited to: enthalpy, activation energy, endothermic, exothermic, potential energy, and specific heat capacity

**D2.3** solve problems involving analysis of heat transfer in a chemical reaction, using the equation Q = mcΔT (e.g., calculate the energy released in the combustion of an organic com- pound, and express the results in energy per mole of fuel [J/mol])

**D2.4** plan and conduct an inquiry to calculate, using a calorimeter, the heat of reaction of a substance (e.g., the heat of solution of ammonium nitrate, or of combustion of a hydrocarbon), compare the actual heat of reaction to the theoretical value, and suggest sources of experimental error

**D3.1** compare the energy changes resulting from physical change (e.g., boiling water), chemical reactions (e.g., bleaching a stain), and nuclear reactions (e.g., fission, fusion), in terms of whether energy is released or absorbed

**D3.3** explain how mass, heat capacity, and change in temperature of a substance determine the amount of heat gained or lost by the substance

**Materials Required:**

**Safety**

You will be burning food. None of it is extremely flammable, and it will burn out gradually. At this point, when it is cold, you can throw it in the garbage.

* 2 retort stands with test tube clamps 2 test tubes
* 2 test tubes matches
* 2 thermometers scale (to 0.1g)
* Two snack foods (chips/cheetos) water (2x 10ml)
* Forceps/tongs

**Pre-questions:**

Suppose we want to see which snack has more energy in it, how might we go about doing that? (explain that burning something is the same idea as digesting it)

How might I measure this? Why do I need to involve the water?(because you can’t hold the thermometer in)

Note: hold the largest part of the food with the forceps. It will break apart as it burns. You don’t want it to fall.

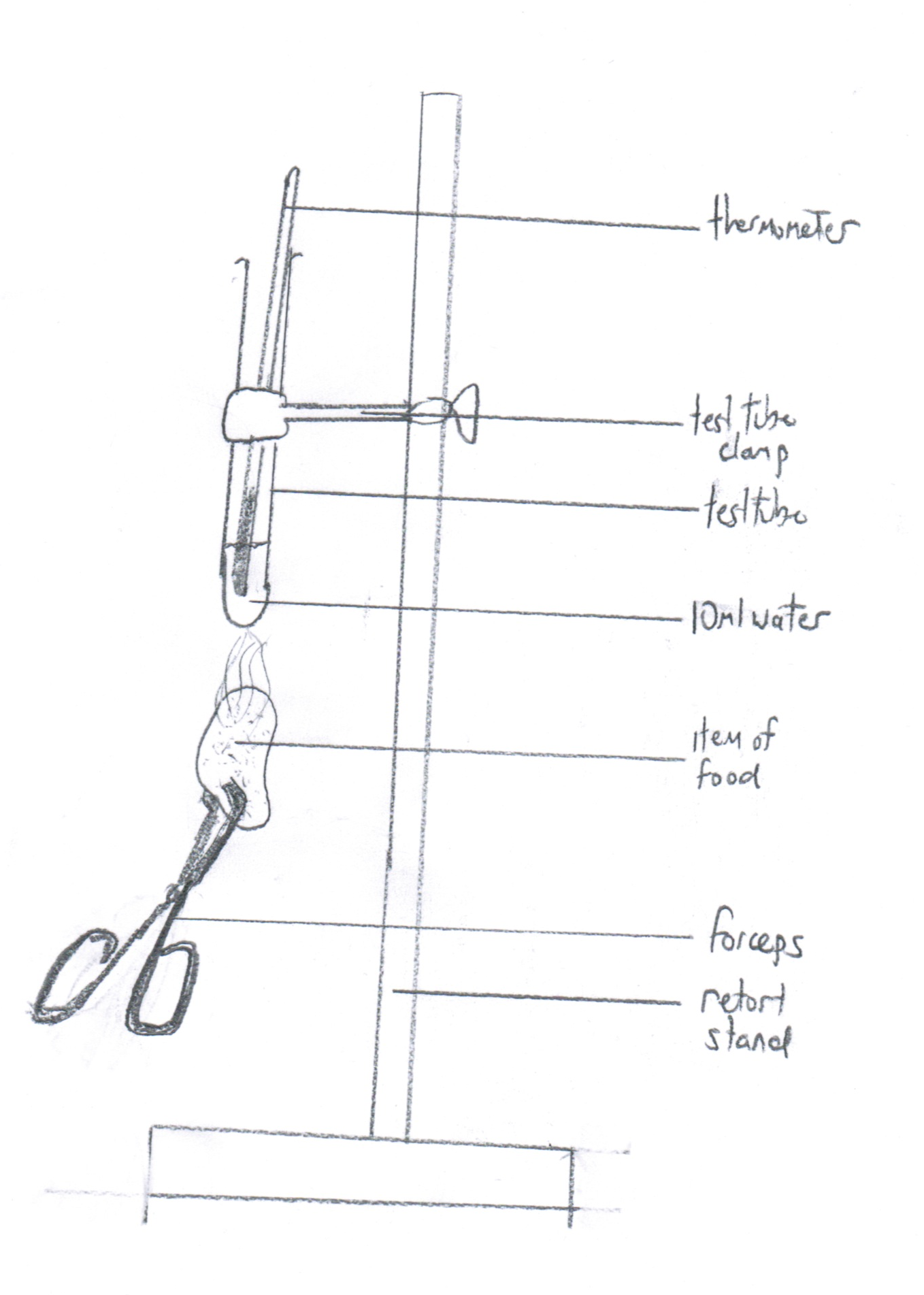
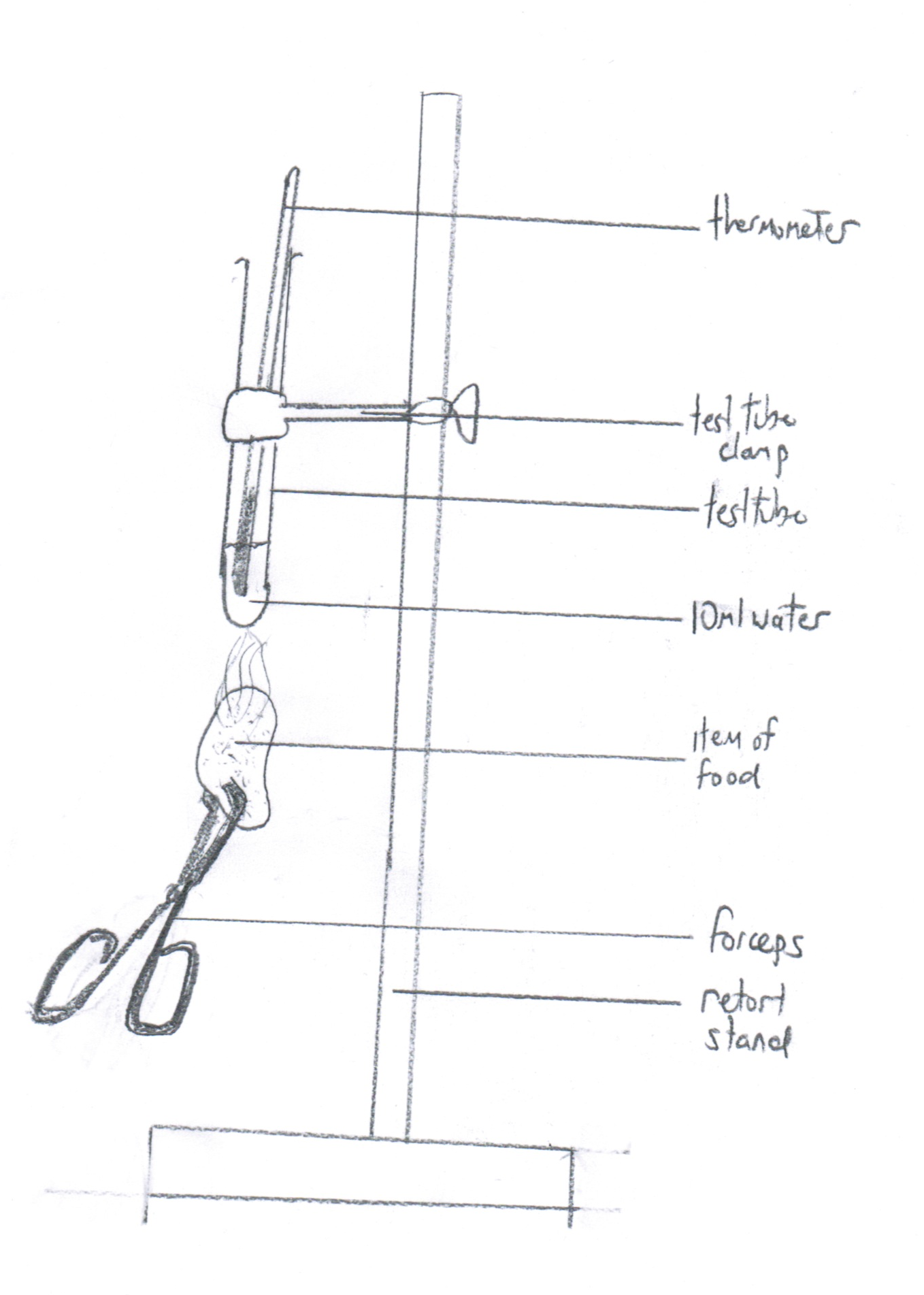
**Procedure:**

1. Set up two versions of the retort stand with clamp and test tube with 10ml water and thermometer in each (as shown).

2. Ask students at the front to take an initial temperature reading from the thermometers.

3. Display the food to be burnt, ask students which they think will have more calories. Explain that the sample pieces weigh the same, or, provide the weights.

4. Hold the food with forceps Light the food with a match and hold it under the test tube.

5. Let the food item burn out completely, ask students to read final temperature. Record final temperature. Repeat for other food.

**Debrief:**

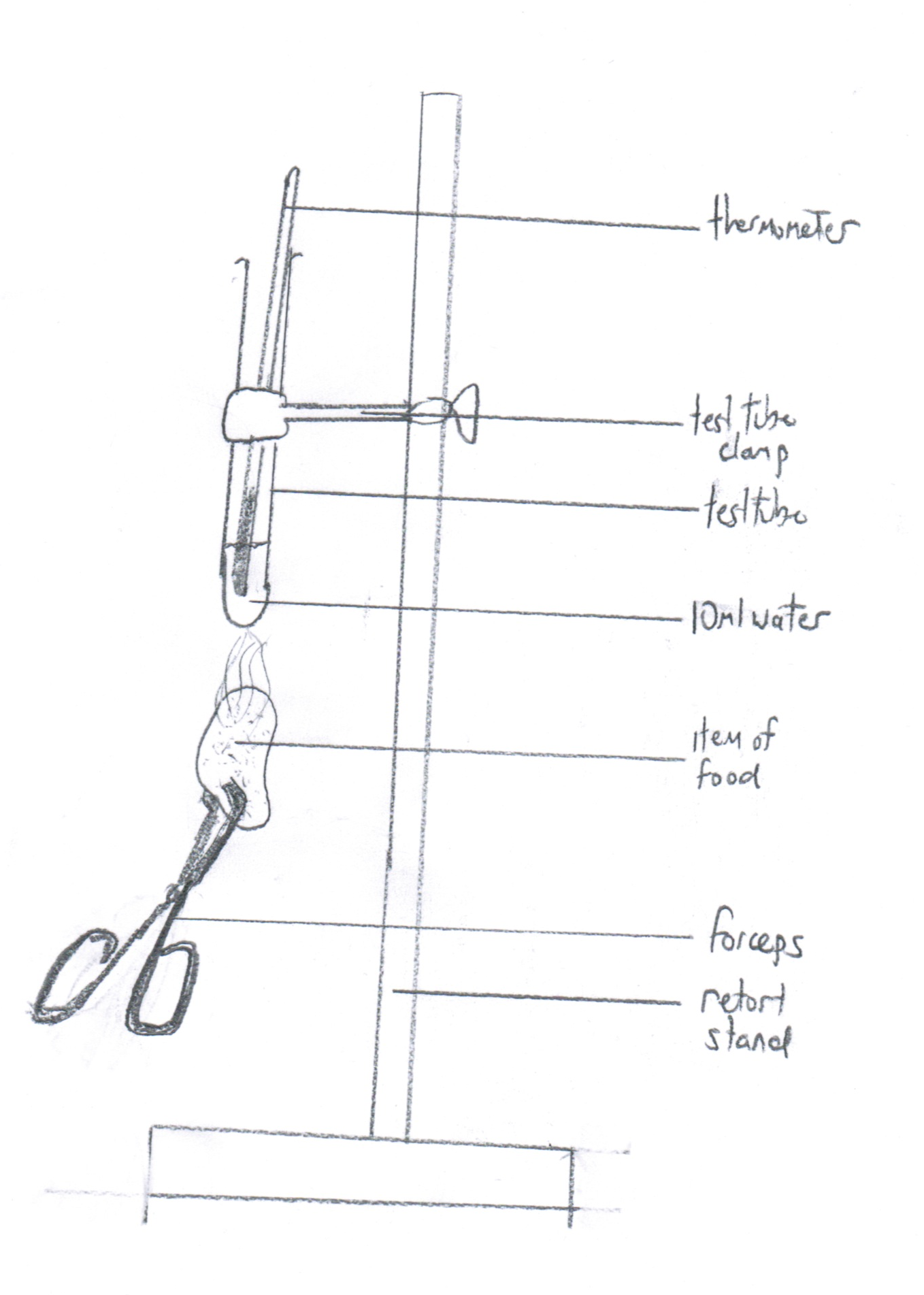
Did this cause the temperature change expected?

When you saw something dripping down from the reaction, what was it?

What are some limitations to this experiment? Sources of error? Did we capture all the heat? What sort of a system is this?

**Adaptations:**

I used this as a demo and had other labs for calorimetry (heat of the Bunsen burner flame, enthalpy of salts), but this could very easily be turned into a lab. My rationale was that burning the food openly was poor calorimetric technique, plus it is harder to monitor and not the most predictable.



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What is heat?

Why might we want to measure heat?

What is the purpose of our demo?

What is the purpose of the test tube with water?

Observations:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Food | Initial Temp | Final Temp | ∆T | Q absorbed by water |
|  |  |  |  |  |
|  |  |  |  |  |

Assume 10g of water was used, and the specific heat capacity of water is 4.184J/g˚C

How much energy was released by each snackfood?

Draw an energy transfer diagram (system/surroundings, and energy/matter flow) for

a) the food as the system b) the water in the test tube as the system

Suggest sources of error for this lab

What are the advantages of using a real calorimeter?